

BULLETIN

The American Academy of Arts and Sciences

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The 1506th Stated Meeting Wednesday, October 14th House of the Academy

Earl Warren, former Chief Justice of the United States, will deliver the communication at the October Stated Meeting. Mr. Warren led the Supreme Court from 1953 to 1969 following a ten-year term as governor of the state of California. He is currently serving as a member of the Panel of Academy Advisers of The Assembly on University Goals and Governance.

The meeting will be held at the House of the Academy on Wednesday, October 14th, beginning at 8:15 p.m. It will be preceded by cocktails starting at 6:30 and dinner served at 7:00.

A dinner reservation card is enclosed for resident Fellows. The price of the dinner is \$5.00 each for Fellows and their wives and \$6.00 each for other guests. Reservations will be accepted in the order in which they are received.

Stated Meetings for 1970-1971 will be held on the second Wednesday of each month on the following dates: October 14th, November 11th (Veterans Day), December 9th, January 13th, February 10th, March 10th, April 14th, and May 12th. All nonresident Fellows or Foreign Honorary Members who expect to be in the vicinity of Boston on those dates are cordially invited to attend.

Automobiles should enter the drive from 165 Allandale Street and leave by the drive to Newton Street.

In Search of the Environment

Science, once revered as the source of great achievements and monumental discoveries, has, in recent years, become the focus of widespread disillusionment, even hostility. The roots of this loss of confidence are symbolized by the term "environment" and encompass such questions as man's place in nature, the rational assessment of social and political priorities, and the dangers inherent in scientific and technological innovation.

In a communication presented at the 1505th Stated Meeting, Joshua Lederberg, Professor of Genetics at the Stanford University School of Medicine, outlined the principal factors that have contributed to the growth of this antiscientific ideology. In particular, he discussed the processes by which scientists, humanists, and all people dedicated to the scholarly and analytical approach can act together to ameliorate some of our increasingly urgent social problems and to improve the quality of human life. The 1505th Stated Meeting was organized by the Executive Committee of the Western Center and was held at the Stanford University Faculty Club in May 1970.

At the outset of his communication, the speaker emphasized that "antisocialism" has, at its source, a number of interwoven irrational and rational arguments. Turning first to the irrational components, Mr. Lederberg pointed out that science has become a scapegoat for the consequences of our complex life, for the affluence which is responsible in part for the boredom that contributes to campus unrest, and even for the high level of literacy that exists throughout the world. The fact that so many people are ready and able to communicate is one of the most intrusive mixed blessings of modern existence. It is indeed ironic that science should bear the blame for the unfortunate side-effects of a system which, largely through the exploitation of scientific advances, has enabled an increasing number of people to engage in the individual pursuit of happiness.

Among the fruits, bitter and sweet, that science has inspired are a demand for realism and a sensi-

tivity to the existence of problems that, in another era or in a state of ignorance, might have been shrugged aside. Mr. Lederberg recalled that recently he had encountered a volume entitled *The Frustration of Science*, edited in 1935 by Frederick Soddy, the discoverer of isotopes and a recipient of the Nobel Prize. Given its title, he felt that the book might provide a useful insight into the problems currently facing the scientific community. He was startled to discover that in the mid-thirties, the contributions of both scientific technology and scientific ideology to *over-production of food and other agricultural products and to a concomitant decline in the birth rate* were regarded as among the most serious threats to the continuance of modern life. How foreign that seems today!

As J. B. S. Haldane eloquently wrote, science invigorates ethical imperatives by exposing problems that were insufficiently perceived earlier and by providing the power and, thus, the responsibility to develop effective solutions. When science fails to meet this responsibility, it faces the most revolutionary impetus of all—the arousal of partially achievable expectations. In this sense, the community of scientists suffers from the very consequences of its own success in rational inquiry.

Although he terms the foregoing complaints irrational, Mr. Lederberg does not deny either their substance or their reality. In the past, the most bitter attacks against science have centered on its seemingly lofty and insidious denial of the nonrational. At the same time that it pretends to be value-free, it supports a system in which the nonscientific is *de facto* of no importance. To illustrate this concept, Mr. Lederberg noted that the student assault on the new Astronautics Building at Stanford last spring was not a random event. The meaning in that madness stems not from the simple presence of an astronautics building on campus but from the contrast between the affluence and splendor of that structure and the poor facilities accorded other fields within the university.

The imbalance in the financial and moral sup-

port received by a department of ethics as compared with a department of astronautics is a situation "deplored" by the entire academic community. Nonetheless, it is a simple fact that while Congress will readily appropriate funds for some fields, it will steadfastly refuse to support others. Many scientists manage to "bootleg" a concern for the humanities into their professional and private thoughts, but they continue to tolerate this imbalance and even dismiss it as a distressing state of affairs for which the rest of society should be held accountable. Mr. Lederberg added, however, that at the present time there are no acceptable means of rapidly altering the status quo; a single institution can do little to reverse this situation and thus it remains part of the symptomatology of campus upheavals.

The growing intensity of antiscience attitudes may seem far removed from such pressing issues as Vietnam, poverty, and the breakdown of democratic decision-making in this country. Yet Mr. Lederberg believes that a nexus can be found in the social revolution now transforming society and specifically in the style in which the final dissolution of the feudal order is directed. The rather monotonous pigmentation of those present at academic gatherings is enough evidence (and far from the worst) of a residue of hereditary privilege in America. To be sure, this residue is being pulverized, and the potential results are subject to much speculation. Will we have a new feudalism or a new fascism as has occurred in the wake of every European revolution? Will we pursue an even more inhumane meritocracy by efficiently chasing ultimate disillusionments or will all our values be erased in favor of an uncompromising egalitarianism possessing noble ends but hopelessly lacking the means to sustain itself against the realities of harsh nature and brutal men? Or will the hope of many concerned individuals be fulfilled by the realization of a pragmatic and creative compromise of these polarizing ideologies?

The human meaning of science lies at the very center of this conflict. The egalitarian faction alleges that the dispassionate search for objective

truth is, in principle, a denial of subjective human nature. The establishment, on the other hand, terms pure science impractical, although the corporate military sector will happily support the search for knowledge when this relates to its particular tasks. Scientists have devoted great ingenuity and a not insignificant part of their time to developing ways to pursue dispassionate research in this milieu; at times they have gained the cooperation of a bureaucracy that strives to defend the over-all system by wisely diverting congressional attention from individual projects. The more talented scientist will undoubtedly survive the current system with only a little prostitution. Even so, he would prefer to work within the established boundaries; the radical alternative is nothing more than mass rape in the name of narrowly-prescribed social ends that would compel us to think solely in accordance with the mood and fashion of the moment.

Mr. Lederberg remarked that for the greater part of his own life, he had adopted an irrational defense of science based on what might be termed the "Promethean argument": the concept that man is essentially a rational animal and the search for knowledge is an *absolute* good that must not be tampered with on any account. In his "more senescent" years, however, he has found himself unable to insist on absolute values as such. Rational intellectual pursuit will always be regarded as the distinguishing characteristic of man, but rationality is only one of the components of human behavior, and other values should be granted an equal claim to the absolute good.

Today we live in a culture framed by the atomic bomb. All of the irrationality about science is said to be a consequence of that particular fruit of scientific development. Hiroshima seared the consciences of many scientists. Mr. Lederberg himself was just twenty years old and already involved in the field of microbiological research when the bomb was dropped in August, 1945; from this detached perspective, he maintains that the impact of the bomb on human values has not been accurately assessed. The world of the bomb

is frightful indeed, but would it have been so different if nuclear development were a latent and still unrealized possibility rather than an actual fact? In reality, atomic weapons have caused only a trivial fraction of the death and destruction that has occurred in the present century. Scientists have insisted that the bomb has made war obsolete; however, it is not instruments but rather the concept of total mobilization of national resources that has exerted the most significant impact on the nature of military conflict. Scientists also assert that atomic energy would be an unmitigated blessing if only the social system could learn to manage it. What a pity our moral skills have not kept pace with our scientific ones!

In this area, in particular, science has been blamed for the wrongs of the social order. There are those who contend that guilt rests solely with the man who pulls the trigger, not with the inventor of gunpowder, yet there are clear limits to the doctrine of the moral neutrality of the instrument and its inventor. Many of our difficulties can indeed be traced to the precarious order of the existing milieu; nonetheless the best-ordered world could be intolerably stressed by forces developed by scientific investigation. Consider the consequences of building a home-made hydrogen bomb. Even if conceived only as a metaphor, this possibility opens the door to an examination of the rational complaints about the shadow side of human knowledge and about its potential stresses as well as benefits to even the most ideal of societies.

Mr. Lederberg asked for a nonpolemical analysis representing neither a reactionary defensive approach nor an attempt at a radical polarization of ideologies. It is essentially an effort to assess the impact of science on the quality of human life in a manner that does not epitomize science as the scapegoat for the sins of society nor as its *raison d'être*. This concept takes on greater meaning when viewed within a specific context; in Mr. Lederberg's case, that context was the potential impact of new findings in molecular biology, including the enzymatic synthesis of DNA and the transfer of genetic information from cell to cell.

After considerable thought, he concluded that even without very optimistic assumptions about the future of society, the strains will probably be manageable or at least reducible to the kinds of problems already before us. Despite its eventual impact, "genetic engineering" will not alter the progress of social evolution in any decisive or sudden way nor will it provide dictators or democrats with radically different tools to mold human behavior according to their own desires.

There is, however, one serious exception to this somewhat optimistic outlook: the exploitation of molecular biology for military purposes, specifically in the development of biological weapons. The revulsion over the homicidal use of science has been escalated beyond rational discussion by the moral and political faults of the Vietnam war. The prospect of biological weaponry, however, inspires deep anxiety in itself. Military research regards this as merely another category of development, but, in reality, it is a unique and horrifying instrument, the functional equivalent of the home-made hydrogen bomb. This argument and others put forth by concerned advisers and independent observers formed the basis for President Nixon's decision to renounce the use of all biological weapons, to halt virtually all germ-warfare research, and to pledge this nation to work for the adoption of international agreements to prevent man-made innovations from becoming the source of epidemics. If the Russians eventually respond in kind, this decision may set in motion a vital social defense in sufficient time to avert the universal germ bomb.

However, the prospect of effecting such agreements does present an interesting paradox. Control of biological weapons would not be feasible without the overriding balance of nuclear terror that regulates the geopolitical system at the present time. Neither the United States nor the Soviet Union could afford to abandon the development of biological weapons if they did not already possess the major strategic deterrent represented by nuclear armaments. Since the nature of biological agents places them beyond the realm of inspec-

tion, prior verification of agreements would be virtually impossible. Yet given the existence of alternative methods of deterrence, it is credible that the major powers would keep their promises and faithfully adhere to an international accord.

Before discussing the various categories of scientific fruits, Mr. Lederberg commented briefly on the current state of the institution of science. The conduct of scientific teaching and research is also under attack at the present time. Critics charge that the practice of science is a wasteful diversion of material resources better spent on more urgent tasks. In actuality, the share of society's resources allocated for basic research represents less than one fifth of one per cent of the gross national product, a sum equivalent to a mere two-week period in the GNP's average incremental growth. Less ethereal is the doctrinal complaint that the institution of science is necessarily coupled to expertise; by generating experts, it establishes an inegalitarian satisfaction based on competence. Undeniably some people will always know more than others — even though this fact may be in conflict with some versions of the egalitarian dogma. Finally, the fear has been expressed that scientific investigation may, in fact, justify a caste system by demonstrating unalterable biological differences among radical groups, differences that would influence their capacity to carry out academic work. Mr. Lederberg contends, however, that we need look no further than the genes for obvious pigmentation and the further reverberation of skin color in the social domain.

The speaker then turned to his concept of a framework for the orderly classification of technopathy or technological injury. Although systems of this type are not readily adapted to a neat scheme, this particular attempt has been drawn along the lines of the welfare and power motives involved in scientific and technological innovation:

1. Pure science is neutral in motive. Immediately directed toward the welfare of the scientist himself, such investigations satisfy his own curiosity and earn him both a living and the esteem of his colleagues. Its results are eventually diffused

throughout the entire structure — to colleagues, students, deans, industry, congressmen. The wise society most efficiently reaps the practical public rewards of private genius by allowing its scientists to follow their own directives without requiring them to justify their work before an exterior establishment. That society must be aware, however, that pure science has often had revolutionary ideological impacts as exemplified by the classic confrontation between science and religion that continues to the present day.

2. A second category of scientific work is carried out in the service of special class interests or is, at least, motivated by such interests; thus, it influences the distribution of power or welfare within the system. It may enhance the power of one corporation over another, of one government over another, of the government over its individual citizens, or of one group of individuals over another. In the end, it acts to widen the gap between the already rich and the already poor.

Concern over the military-industrial complex has given new impetus to the plea for a moratorium on science. Advocates of this notion, which in one form or another dates back nearly sixty years, argue that all science and technology should be halted at least until our national goals have been restructured. Mr. Lederberg emphasized that if such a movement were to gain political strength, it would mean the abandonment of free science and the continued operation of only a subservient technology that offers its sponsors an "obvious payoff"; for whoever pays the price, this form of technology promises to return an important and valuable investment. True military security can be pursued and eventually achieved only if the nation is united behind commonly accepted and perceived goals. This liberal pursuit is far preferable to the scientist than the proposed radical cures which exact their special prize in blood.

3. In addition to neutral basic research and investigations motivated by class interests, there remains a major area of pure science and technology directed primarily at the general welfare. Within this category lies the vast field of health research

which is basic in nature yet capable of making significant contributions to human well-being.

Many of our most serious environmental problems are the result of welfare-oriented research that was insufficiently prosecuted or carried out in a framework too constrained to reveal all the ramifications of a specific "solution." DDT, nuclear energy, chloramphenicol were initially hailed as panaceas yet each has generated its own dangers. The technical term for this state of affairs is *suboptimization*; essentially, it is the act of doing a beautiful job in solving the wrong problem by incorrectly framing the question and by relying on a poor scientific base for an analysis of both the benefits and the hazards of a proposed solution.

Environmental crises are, in Mr. Lederberg's mind, the result of ignorance as much as of venality. If we could verify the health as well as the ecological consequences of the widespread distribution of DDT, political action would follow with little delay. Unless we fully understand all the consequences of scientific and technological development, we will fail to identify the areas that require the most current attention and justify the most costly investment.

The scientific community could best apply its special talents by making critical and pluralistic attacks on the problems of society. The free university would be the ideal means of institutionalizing innovative, unconstrained scientific research within our society. Its freedom is under radical attack by zealots who see no need for further inquiry, only violent action. It is also prejudiced by the withering of its fiscal autonomy when its most important resources are for hire, and it has lost the means to decide for itself which ends are most worth pursuing.